FLARE TANK APPARATUS FOR DEGASSING DRILLING FLUID

Technical Field

[0001] The invention pertains to a flare tank apparatus for use in safely separating combustible gases from the fluid produced in oil and gas drilling operations.

Background

[0002] Flare tanks are used in oil and gas drilling operations for disposing of combustible waste gases in a manner that protects oilfield workers. For example, they are commonly used to burn off the small pockets of gas encountered during drilling. They also separate the liquids mixed with the waste gas, such as water and drilling mud, and hold them for disposal by environmentally acceptable means in order to prevent ground contamination. Prior art flare tank apparatuses are described, for example, in U.S. Patent Nos. 5,807,095, 5,882,187 and 5,997,284 (Gustafson et al.).

[0003] Flare tanks may be portable apparatuses that are moved to job sites as needed. At a job site, the flare tank is connected to a flare line, i.e. the conduit that extends from the drill string and carries to the flare tank the liquid and combustible gases to be treated. In the prior art, a connection between the outlet end of the flare line and the inlet of the flare tank apparatus is made by welding a connecting member therebetween. The use of a welded connection increases the cost of both connecting and subsequently disconnecting the flare tank apparatus. It would be desirable to provide a flare tank apparatus having improved means for convenient connection to the flare line.

Summary of Invention

[0004] The invention provides a flare tank apparatus for separating combustible gases from a mixture of such gases and a liquid. The apparatus has a degasser for receiving the gases and liquid, with an inlet port, a liquid outlet port and a gas outlet port. A holding tank is operatively connected to the liquid outlet port of the degasser for receiving the liquid that has been separated in the degasser, at least partly, from the gases. The apparatus has a flare stack for conveying the gases from the gas outlet port of the degasser to a burner where they can be burnt off. The apparatus includes an inlet conduit that is operatively connected at one end to the inlet port of the degasser and is adapted to be connected at its second end to a flare line. The inlet conduit comprises at least two connectors which permit components of the inlet conduit to swivel relative to each other. The connectors can be loosened to permit such swivelling without disassembling the inlet conduit. When the connectors are tightened, the components no longer swivel, locking the inlet conduit in position for use. The swivelling of the connectors permits the free end of the inlet conduit to be moved and positioned for easy connection to the outlet end of the flare line.

[0005] According to preferred embodiments of the invention, the inlet conduit preferably comprises at least four elbows which each define an angle of approximately 90 degrees. It preferably comprises a conduit section that connects to the flare line in a substantially horizontal position. The inlet conduit folds to a compact position against the holding tank for transport of the apparatus.

[0006] The holding tank is preferably an open-top tank and the degasser is positioned within the holding tank and extending upwardly therefrom.

[0007] The inlet port of the degasser is preferably positioned such that part of its area, for example one half, is above and part is below an upper edge of the side walls of the holding tank.

[0008] The inlet port of the degasser may be in a side wall of the degasser and the inlet conduit may comprise a conduit section that connects to the inlet port in a generally horizontal position.

Brief Description of Drawings

[0009] Figure 1 is a perspective view, partly in cut-away, of a preferred embodiment of the flare tank apparatus, with the inlet conduit extended for connection to a flare line.

[0010] Figure 2 is another perspective view of the flare tank apparatus, with the inlet conduit folded adjacent to the side wall of the holding tank for transport.

[0011] Figure 3 is a top plan view of the apparatus shown in Figure 2.

Description of the Preferred Embodiments

[0012] Flare tank apparatus **10** comprises principally an inner tank or degasser **12** and an outer tank or holding tank **14**. The holding tank **14** is an open-top cylindrical tank having a bottom wall **16** and side wall **18**. The walls may comprise a double shell for strength and worker safety. The flare tank apparatus is affixed to a skid **15** to facilitate lifting and transport.

[0013] The degasser **12** is a cylindrical tank having a side wall **20**, bottom wall **22** and upper wall **24**. A flare stack **26** is affixed to the upper wall **24** which has a gas outlet port **28** therein, whereby the interior of the degasser is open to the stack **26**. The side wall **20** has liquid outlet ports **30** therein at is lower edge, whereby liquid (principally drilling mud) in the degasser can flow into the holding tank **14**, as described below.

[0014] An inlet conduit **32** is adapted to conduct fluid from a flare line **62** into the degasser. It comprises components to facilitate both connection to the flare line and compact placement against the side wall **18** of the holding tank **14**. A straight pipe section **34** connects to the inlet port **36** of the degasser. The connection is preferable approximately horizontal. The pipe section **34**, or an extension therefore, extends into the interior of the degasser **12** and is directed approximately horizontally towards a wear plate **38**, which is welded to the side wall **20**. It is possible for the wear plate to be omitted from the apparatus, in which case incoming fluid will directly strike the side wall of the degasser. However, to protect the side wall from excessive wear, a wear plate is preferred.

[0015] The outer end of pipe section **34** is connected to an elbow **40**, which (like the other elbow components of the inlet conduit **32**) forms an angle of approximately 90 degrees. A straight pipe section **42** is connected to the other end of the elbow **40** and is positioned generally vertically adjacent to the outer wall **18** of the holding tank. The lower end of the pipe section **42** is connected to an elbow **44** by a union **46**. The elbow **44** can be swivelled relative to the pipe section **42**, by virtue of the union **46**. The union **46** is preferably a hammer union, having wings **48** (best seen in Figure 3) that permit the union ring member **50** to be turned by hammer blows in order to tighten and loosen the union

46. Hammer unions of the type used in the inlet conduit **32** are commercially available connectors that are well known in the pipefitting arts. When a union is loosened, the components on either side of it can be swivelled relative to each other without disassembling the inlet conduit.

[0016] The elbow **44** connects at its other end to a straight pipe section **52**, which in turn connects to an elbow **54**. The elbow **54** is oriented such that its other end is directed approximately vertically downward. Elbow **56** is connected to elbow **54** by a union **46A**, which is identical in structure to the union **46** and which permits the elbow **56** to be swivelled relative to the elbow **54**. A straight pipe section **58** is connected to the other end of the elbow **56**, extending approximately horizontally. The open end **60** of the pipe section **58** is preferably threaded and is adapted for connection to the flare line **62**.

[0017] The degasser inlet port **36** is positioned such that approximately half its area is above and half is below the top edge **64** of the holding tank **12**, i.e. its centre point is at about the horizontal level of the edge **64**. As a result, the top half of the pipe section **34** is above the edge **64** of the flare tank, for reasons discussed below.

[0018] A suction pipe **66** is attached to the side wall **18** of the holding tank by brackets **68**. It is open at both ends and extends from adjacent the bottom wall **16** on the inside of the holding tank to the lower part of the outside of the holding tank. It is used for removal of liquid from the holding tank.

[0019] The flare stack **26** has a burner **70** at its top end, fed by a gas line **72**. The top end of the flare stack and the burner are surrounded by a cylindrical windguard **74**. The flare stack may be

extended by one or more extension pipes extending vertically therefrom so that the top of the stack, and the burning of combustible gases at the top, is at any desired height above the ground.

[0020] If desired, the flare tank apparatus may be configured to hold more than one degasser, for example two or three degassers, within the holding tank, to provide backup or greater drilling fluid handling capacity.

[0021] The flare tank apparatus is preferably constructed of steel that has qualities of strength and corrosion resistance suitable to the application. The apparatus may be of any appropriate size. By way of example, the degasser may be about 42 inches in diameter and ten feet high; the flare stack may be about five feet high; the holding tank may be about eight feet high, and the inlet conduit may be about eight inches in outer diameter.

[0022] The flare tank apparatus **10** is used in the following manner. Once positioned in a suitable location relative to a flare line, the end **60** of the inlet conduit **32** is connected to the flare line **62**. To do this, unions **46** and **46A** are loosened and the elbows **44**, **56** are swivelled as necessary to position the pipe section **58** for connection to the flare line. The unions **46**, **46A** are then tightened to secure the inlet conduit **32** in the desired position. Gases and liquids from the drill string are allowed to flow into the degasser **12** through the inlet conduit **32**, typically at high pressure, and strike the wear plate **38**. Within the degasser, the gases and liquids tend to separate. The gases, being lighter, rise and exit the degasser through the gas outlet port **28** and stack **26**, and are burned off at the top end of the stack. The liquids, being heavier, fall to the bottom of the degasser and flow out through the outlet ports **30** into the flare tank.

[0023] When appropriate, liquid is removed from the holding tank by applying suction to the outer end of the suction pipe **66**. It will be apparent that liquids in the bottom of the holding tank and the degasser will come to a common level. If the holding tank fills to its upper edge **64**, liquid will flow out over its side walls **18** (though it will be understood that liquid should be suctioned out of the holding tank before that occurs). However, since the upper half of the pipe section **34** is above the level of the upper edge **64**, gas and liquids can continue to flow into the degasser **12**, even though the bottom half of the pipe **34** may be obstructed. Likewise, freezing of the liquid in the bottom half of the pipe section **34** (which can occur where the apparatus is used in cold conditions and the holding tank is full) will not prevent inflow through the top half of the pipe section **34**. Although the inlet port could, in principle, be positioned fully above the level of the upper edge **64** of the holding tank, since liquids can, at least temporarily, fill the degasser up to the height of the inlet, any raising of the height of the inlet port would reduce the free space within the degasser, resulting in reduced efficiency of separation of gases from liquid in the degasser. The positioning of the inlet port so that its centre is at the horizontal level of the top edge **64** of the holding tank is therefore the optimal position.

[0024] Some amount of combustible gases may still be present in the liquid in the bottom of the degasser and in the holding tank, since complete separation of the gases and liquid may not occur. To protect oilfield workers from the hazards posed by such gases, the side walls of the holding tank are preferably higher than the height of a worker.

[0025] When use of the flare tank apparatus is completed, the inlet conduit **32** is disconnected from the flare line **62**. The inlet conduit is

then arranged against the outer wall **18** of the holding tank for transportation from the job site. To do this, the unions **46**, **46A** are loosened and the elbows **44**, **56** are swivelled so that the portion of the inlet conduit below the union **46** is positioned as flat as reasonably possible adjacent to side wall **18**, as shown in Figures 2 and 3. The unions are then tightened to hold the inlet conduit in this position. The compact placement of the inlet conduit against the holding tank wall greatly facilitates road transport of the apparatus and can avoid the need for a pilot car that is required for oversized loads.

[0026] It will be apparent from the foregoing description and from consideration of the drawings that the combination of two connectors in the inlet conduit that can be swivelled permits the end pipe section **58** of the inlet conduit to be moved to a variety of positions for connection to the flare line **62**. In practice, this means that the flare tank apparatus can be unloaded at the job site close to the end of the flare line, without careful positioning, and then easily connected to the flare line by movement of the inlet conduit so that pipe section **58** is aligned with flare line **62** and their respective ends abut each other and are sealed together by a convention threaded fitting. A special welded connection between the inlet conduit and the flare line, as in the prior practice, is unnecessary.

[0027] Because of the high pressures commonly experienced in the inlet conduit, the number of right angle turns should be minimized. In the preferred embodiment, there are four such right angle elbows (namely elbows **40**, **44**, **54** and **56**), which has been found acceptable in use. It will be apparent to the reader that the configuration of the inlet conduit of the preferred embodiment, in addition to facilitating connection to the flare line, permits the inlet port of the degasser to be at a higher elevation than the flare line (which ordinarily runs along the

ground). This is desirable in providing greater volume within the degasser that is below the level of the inlet port and accordingly a greater working volume.

[0028] Although the invention has been described in terms of its preferred embodiments, it is not intended that the invention be limited to these embodiments. Various modifications within the scope of the invention will be apparent to those skilled in the art. For example the inlet conduit may comprise additional connector unions to permit further adjustment of the position of the inlet conduit; e.g. a union in place of pipe section **52** would permit adjustment of the vertical position of end **60** of the inlet conduit, if that is desired. The scope of the invention is defined by the claims that follow.